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MOSCOW BEARING PLANT SPENDS FIVE YEARS ON COLD STAMPING PROCESS

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For more than 5 years, the Moscow First State Bearing Plant and ENIIPP (Experimental Scientific Research Institute of the Bearing Industry) have been developing a process for cold stamping rings for tapered roller bearings from 18KhGT steel. Five years is ample time for perfecting such a process and introducing it into production. This article will review the difficulties encountered in developing this process and will outline the future problems of cold stamping.

In 1948, Candidate of Technical Sciences Yu. L. Rozhdestvenskiy of ENIIPP calculated that cold stamping could reduce labor consumption 48-50 percent and raise the coefficient of metal utilization to 0.32-0.38, as compared to 0.29-0.36 by the old method. However, this calculation failed to take into account the actual capabilities of the plant and the various stages involved in working out the process. Lack of special equipment, dispersal of the production sections that were developing the new process, and the complexity of the process produced the following initial results: the labor consumption for the first ten types of rings made by the new process was 2-2.5 times that of the original rings, the coefficient of metal utilization was less than 0.32, and rejects or rings made from 18KhGT steel exceeded rejects of rings made from ShKh15 steel. Because of these poor initial results, the plant cancelled its original decision to organize a cold stamping shop with a closed technological cycle.

Work at the plant in the last 2 years shows that, by solving basic technological problems, the cost of cold stamped rings can be brought below that of forged rings, and that cold stamping of mass-produced rings for tapered bearings would enable the plant to raise the coefficient of metal utilization to 0.55-0.60 (compared to an average of 0.4 in the forging shop) and to reduce labor consumption to the planned level. However, these results could only be achieved by a radical increase in the scale of production of cold stamped rings and by reorganizing production.

Let us review the basic technical and economic indexes of the cold stamping process.

Labor Consumption

When the cold stamping process was first introduced (1949-1950), the labor consumption of rings increased, mainly because of heat treating operations which were several times as labor consuming as the entire original process. The new process for stamping rings from 18KhGT steel made casehardening necessary. This in turn made it necessary to install a continuous furnace for casehardening and quenching. Moreover, warping of rings after casehardening and quenching made it necessary to use dies in the hardening process (for rings with outside diameter of 70 millimeters or more). Use of the shaft furnaces at the plant for casehardening, and quenching in dies without automatic equipment, greatly increased the labor consumption of the heat treating shop.

In this early period, there was no reduction in the labor consumption of lathe operations. Though the amount of chips to be removed was reduced 8-10 times, labor consumption for machining cold stamped rings in the automatic lathe shop was 10-30 percent higher than it was for forgings made of ShKh15 steel. There are two possible explanations for this increase in labor consumption: 1. The plant did not have

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proper production equipment, such as automatic chamfering machines. 2. Workers in the automatic lathe shop tried to use the initial period of the new process for establishing low output norms. This latter factor also applied to the heat treating shop.

The heat treating shop has reduced labor consumption 400 percent and the automatic lathe shop reduced labor consumption 50-60 percent.

The cold stamping shop could not immediately attain planned labor consumption because the volumetric precision stamping process had not been perfected and the tools were not durable enough. At the beginning of 1951, the labor consumption of stamping operations was, on an average, twice that of the original process (forging on horizontal forging machines).

In 1951 and 1952, the cold stamping shop perfected the volumetric precision stamping process, making it dependable and fully automatic. The process was adapted for stamping outer rings up to 140 millimeters in diameter and for making rings for universal joint bearings. By the end of 1952, the durability of stamping tools had been increased 2-3 times (durability of calibrating dies was increased six times), while total expenditures on tools decreased 2.5 times. During this period, a 100-ton Weingarten press was equipped with automatic feed, an 800-ton Pels press was equipped with a belt conveyer, a 750-ton Toledo press was fitted with a conveyer chute which carried forgings to the Division of Technical Control, a 630-ton Pels press for calibrating rings was equipped with automatic feed, a 2,000-ton Schuler press was equipped with automatic hook feed of the strip into a consecutive action cutting-off die, and a 600-ton Eymuko press and a 160-ton Pels press are being equipped with automatic feed.

By January 1953, the labor consumption of the cold stamping operation had been reduced 2-2.5 times. When all the presses have been converted to automatic and semiautomatic operation, the labor consumption of stamping operations will be 30-40 percent lower than forging operations.

Special equipment is being built for the lathe and heat treating shops. ENIIPP has designed and tested an automatic chamfering machine for turning cold stamped rings. In 1953, the plant is to make the first group of these machines for use in mass production. A conveyer casehardening furnace is being set up in the heat treating shop.

Although this special equipment has not yet been put into operation, the automatic lathe and heat treating shops have already managed to reduce labor consumption. In 1950, the labor consumption of lathe operations on cold stamped rings was 20-30 percent higher than the labor consumption in machining forged rings. In 1953, the labor consumption in machining cold stamped rings is 35-50 percent lower than for machining forgings. In 1950, the labor consumption of heat treating operations on cold stamped rings was 60-70 times as great as it was for forgings made of ShKh15 steel: now, labor consumption of heat treating cold stamped rings is only 5-6 times as great as for forgings.

The reduction in labor consumption for the entire process of making 7208/01 cold stamped rings is shown as follows (in percent):

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Labor Consumption at Various Stages of Development	Total Labor Consump- tion	Labor Consumption by Operation			
		Stamp- ing	Turning on Lathe	Heat Treating	Grinding
Original labor consumption (for forgings made of ShKh15 steel)	100	100	100	100	100
Labor consumption of cold stampings in May 1950	223	265	124	7,560	100
Labor consumption of cold stampings in Feb 1953	102	86	65	1,530	104

In 1953, the plant has reached a stage where excessive labor consumption in heat treating operations is compensated for by reduced labor consumption in stamping and turning operations. If all the technological improvements scheduled for 1953 are carried out, an over-all reduction of 25-30 percent in labor consumption for making cold stamped rings may be expected in early 1954.

Metal Utilization

It has already been noted that when cold stamping of rings was first introduced (1949-1950), the coefficient of metal utilization was less than 0.32. The basic reason for this low coefficient was the failure of ENIIPP and the plant's Chief Technologist's Division to select a consecutive series of ring sizes and to utilize central and peripheral portions of the strip steel. In 1951-1952, the cold stamping shop worked out its own layout system by chich a smaller ring was nested inside the basic ring on the strip and a third ring was made from the central disk and the leftover peripheral portions of the strip.

Theoretically, the coefficient of metal utilization in cold stamping of rings can be increased to 0.6. However, an analysis of the list of rings for tapered bearings included in the plant's 1953 plan demonstrated that this figure could be achieved only if there were a considerable increase in the production of cold stamped rings. This analysis prescribed the following program: eight types of tapered bearing rings with outside diameters ranging from 90 to 140 millimeters should be stamped directly from strip in quantities equal to the 1953 program; 26 types of rings with outside diameters of 80 millimeters and smaller would then be stamped from the leftover metal from the center and sides of the strip in a quantity equal to three times the 1953 program.

At present, the cold stamping shop is tied up with a haphazard program which does not permit full utilization of the center of the strip; the sides of the strip are entirely consigned to scrap. Add to this the small scale of the shop's production program and it will become clear why the 1953 coefficient of metal utilization for cold stamping was only 0.4-0.42.

The table below shows comparative coefficients of metal utilization achieved through various processes for making tapered bearing rings.

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Process	Coefficient of Metal Utilization
Cold stamping	0.55-0.60
Profile rolling	0.38-0.45*
Horizontal forging (in closed dies)	0.38-0.41*
Machining from tube stock	0.38-0.4[illegible]*
Smith forging	0.25-0.28*
Fabricating from bar stock	0.18-0.25

*These figures are taken from the book Saving Materials at the First State Bearing Plant, Gossnab USSR, 1952.

Another process now being developed at the plant is hot sizing of rolled rings from ShKh15 steel. The coefficient of metal utilization of this process is expected to be about 0.50-0.52. Hot sizing is used for rings with outside diamters of 150 millimeters or more. A further advantage of cold stamping is that 90 percent of the leftover metal is collected directly in the cold stamping shop, and only 10 percent is collected from shavings in the automatic lathe shop. In the forging method, 90 percent of the scrap is collected in the automatic lathe shop and 10 percent is collected in the forge shop.

Quality

Stand and operating tests show that rings made of 18KhGT steel are as strong as rings made of ShKh15 steel.

In a control test, three rings (7208/01, 7605/01, and 7608/01) were cold stamped and three rings (7215/01, 7609/01, and 7610/01) were forged. In most processes, the reject rate was about the same for both types of rings, but in the heat treating shop the reject rate for cold stamped rings was 12 times as great as it was for forged rings. Most of the rejected rings were out-of-round because of warping during the quenching process. ENIIPP and the Chief Technologist's Division did not fully work out the process for quenching in dies. This process should be improved to reduce the amount of grinding required by the rings and to reduce the reject rate.

In the grinding of cold stamped rings, 80 percent of the rejects were due to incorrect dimensions on the inside and outside diameters.

Production Cost

Two years ago, the production cost of cold stamped rings made of 18KhGT steel was 2-3 times greater than the cost of forged rings made of ShKh15 steel, but by the beginning of 1953 they cost only 10-20 percent more. Labor costs, the basic element of production costs, are now lower for cold stamping than for forging.

The over-all production cost of cold stampings is higher because of the relatively low coefficient of metal utilization (0.40-0.42) and because of the small production program given the shop. By increasing this program and improving technology, cold stamped rings will eventually cost 10-25 percent less than forgings.

Conclusion

Five years of work by ENIIPP and the Moscow First State Bearing Plant have corroborated the initial estimates of savings by cold stamping rings. However, these savings can only be achieved if cold stamping is carried out on a large scale and organized on a constant flow basis. The absence of a clear-cut plan for cold stamping may have a negative effect on its use throughout the entire bearing industry.

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